# A comparison between palpation method and Johnson's rule to estimate fetal weight in term singleton pregnancies with cephalic presentation in a tertiary hospital: A prospective cross-sectional study*

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**ABSTRACT**

**Background:** Estimation of fetal weight through ultrasound or clinically, is important in the management of pregnant women. In low resource settings, where ultrasound is scarce, determination of the superior clinical method between Johnson's rule and palpation method is of significant value.

**Objective:** The objective of this study was to determine the best clinical method in estimating fetal weight in term parturients in a tertiary government hospital. 140 term mothers with singleton pregnancies in cephalic presentation were included in this study.

**Methodology:** Fetal weight was estimated using both palpation method and Johnson's rule and compared to the actual fetal weight. Effects of body mass index (BMI), cervical dilatation, and engagement on the accuracy of both methods were evaluated using one-way ANOVA and test of proportions. The accuracy of both methods were calculated by mean absolute error and bias. Bland-Altman analysis was used to see limits of agreement and the mean difference between estimated fetal weight to actual birthweight.

**Results:** Mean estimated fetal weight (EFW) was 2846.39 ± 427.29g by Johnson's and 2904.29 ± 372.79g by palpation with a mean actual birthweight of 3028.30 ± 441.52g. Using paired t-test, no significant differences were found in EFW by the two methods and actual birthweight. Palpation had more estimates that differed from actual by < 100 grams at 41.43% compared to 16.43% for Johnson's with $p < 0.001$. Lower bias (7.11%) was seen in palpation compared to Johnson's (12.09%) and with more precise estimates.

**Conclusion:** Palpation method is more accurate and reliable than Johnson's rule. Clinical palpation is easy, cost effective, simple and should be considered as a diagnostic tool for fetal weight estimation especially in rural areas. The effect modifiers are cervical dilation for palpation and engagement for Johnson's. BMI has no effect in accuracy of estimates in both methods.

*Keywords: Estimated fetal weight, Johnson's rule, palpation method*

## INTRODUCTION

Accurate estimation of fetal weight is of paramount importance in the management of pregnant women in terms of labor and delivery.[1] The decision to deliver the baby vaginally or abdominally relies on different factors, but the fetal weight remains an important parameter.

Compared to infants of normal size, very small and very large babies have higher mortality and morbidity.[2,3] Neonates who are small for gestational age have an increased risk of developing respiratory distress syndrome, intraventricular hemorrhage and necrotizing enterocolitis during the perinatal period.[4] Fetal macrosomia, on the other hand, is associated with more maternal and fetal complications at the time of birth than other neonatal weight groups.[5] Maternal complications include increased cesarean rate, higher risk of injury to the genital tract, uterine rupture, and post-partum hemorrhage.[6,7] Due to fetal macrosomia, there is a higher chance of shoulder dystocia, especially during vaginal delivery, that may lead to clavicular fractures and permanent damage to the brachial plexus.[6,8,9] For these reasons, neonatal mortality

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rate and rate of admission to the neonatal intensive care are higher for neonates with macrosomia.[7] Identification of fetal growth abnormalities such as fetal growth restrictions and macrosomia help in making the right judgment for the patient and baby.

Numerous researches concentrated on identifying tools with the least percentage error in EFW. Several researches compared ultrasound to clinical methods and found no significant difference in the estimations.[10,11] In a low resource setting with poor compliance to prenatal care, clinical methods such as Johnson's rule and palpation method are of significant value.

The palpation method is the oldest technique for assessing fetal weight. Position and presentation of the fetus, level of the uterine fundus and disproportion between fetus and maternal pelvis are described by placing the examiner's two hands on the woman's abdomen.[12] This method involves manual assessment of fetal size and is used considerably because it is convenient and virtually costless. A drawback is that it is subjective and associated with notable predictive errors.

A prediction formula for birthweight was first deduced from Symphysis Fundic Height by Johnson. In 1957, Johnson simplified the equation to, EFW (EFW) = 155* (Fundic Height (FH) – n), where n=12 if fetal head is engaged and 11 if unengaged, currently known as Johnson's Rule.[13] The method is not expensive, non-invasive and acceptable to parturients. Furthermore, it is a reproducible technique that is easily learned.[14]

EFW using palpation or Johnson's is a routine obstetric practice. Due to its subjective nature, it was believed to be a weak tool. Previous studies refuted this hypothesis and proved that clinical estimation of fetal weight, though subjective, has significant low percentage errors in approximating actual fetal weight.[7,15-17]

Locally, there is a scarcity of literatures comparing clinical methods hence the need to investigate. A local study by Asto and Crisologo, compared 4 clinical methods of estimation of fetal weight and found that the palpation method was superior with a lowest mean absolute error of 5%.[18] The study was done in a setting where palpation was the routine method. This study intends to determine the superior clinical method in a setting where palpation is not routine.

Despite literatures comparing clinical methods with ultrasound, there is a paucity of studies evaluating clinical variables that may affect the accuracy of EFW. In a study by Field et al (1995), there is no difference in accuracy of fetal weight estimation across all body mass index (BMI) categories.[19] Goetzinger et al (2014) concluded that BMI does not decrease the accuracy of fetal weight estimate made by abdominal palpation.[20] Lanowski et al (2017) noted BMI increases the percentage of error in EFW when using clinical methods.[21] In palpation, where fetal parts are measured, it removes the possible effect of BMI in miscalculating the fetal weight. This study postulates that palpation is more accurate than Johnson's. Another clinical factor analyzed is fetal station or engagement. In the study of Goetzinger et al (2014), fetal station had no significant impact on the accuracy of clinical EFW.[20]

Majority of pregnancies delivered in a tertiary government hospital come from the low socioeconomic group who are at high risk for fetal disorders. In spite of limited access to ultrasonography, clinicians can still accurately estimate the fetal weight using clinical methods and manage the patients appropriately. Determination of which clinical method is more accurate is of significant importance.

## OBJECTIVE

### General Objectives

To establish the superior clinical method in estimating fetal weight in term parturients with cephalic presentation admitted at a tertiary hospital. To compare the accuracy of both palpation method and Johnson's rule in estimating fetal weight.

### Specific Objectives

1. To determine the accuracy of the palpation method in estimating fetal weight compared to actual birth weight
2. To determine the accuracy of the Johnson's rule formula in estimating fetal weight compared to actual birth weight
3. To measure and compare the accuracy of the the clinical methods by calculating:
   a. Statistical agreement via Bland-Altman analysis
   b. Systematic error
   c. Random error
   d. Mean absolute percentage error
4. To determine whether the following factors are effect modifiers in the accuracy of the clinical estimations:
   a. Maternal BMI
   b. Engagement
   c. Cervical dilation (<6cm vs 6cm and up)

## METHODOLOGY

### Study Design

The study uses a prospective cross sectional study design.

### A. Setting

The study was conducted at the Emergency Room (ER) of the Department of Obstetrics and Gynecology (OB-GYN) of the Hospital.

**B. Study population**

The study included women admitted at the Emergency Room of the Department of Obstetrics and Gynecology with a calculated age of gestation of 37 weeks or more in cephalic presentation.

*Inclusion criteria*

The patients recruited were mothers with term pregnancies (37 weeks AOG or more) admitted at the OB-GYN Emergency Room.

*Exclusion criteria*

Patients with age of gestation less than 37 weeks, malpresentation, multiple gestations, placenta previa, known pelvic or intrauterine masses and intrauterine fetal demise were excluded from the study.

**C. Description of study procedures**

Pregnant women at term seen at the Emergency Room Department of OB-GYN who fulfilled the inclusion criteria were asked for their informed consent. The details of the study were explained by the principal investigator.

For each patient recruited to the study, the following details were obtained:

1. Demographics: Age, gravidity, parity, height, weight, BMI
2. Obstetric examination: Leopolds maneuver, Fundic height, Estimated fetal weight by palpation method and internal examination
3. Actual birth weight

The obstetric examination was performed by the ER OB-GYN resident and the principal investigator. The ER OB-GYN residents performed the Leopold exam, fundic height measurement and computation of fetal weight using Johnson's rule, a routine clinical estimation of fetal weight in this institution. The principal investigator on the other hand performed the Leopold's exam and palpation method. The measurements acquired were recorded and the actual fetal birthweights were obtained from the pediatrics record of deliveries. Examiners were blinded from the other examiners' estimates and the mother's hospital records.

*Methods of Fetal Estimation*

1. *Johnson's rule* - The fundic height was measured from the symphysis pubis to the highest point of the fundus using a tape measure. Prior to examination, the bladder should be empty. Station was identified by internal examination. EFW is calculated by using the Johnson's formula:

   EFW (g) = EFW= 155* (FH – n)

   N= 11 if vertex is above the ischial spine (unengaged)
   N=12 if vertex is at the level of or below the ischial spine (engaged)

2. *Palpation method* - This was performed during abdominal examination, where the palm of the examiner was used to palpate for the fetal parts to estimate the fetal weight. Each palm may be equivalent to 400-500 grams depending on the estimate established by the resident through experience.[3]

**Statistical Analysis**

Descriptive statistics was used to summarize the clinical characteristics of the subjects. Frequency and proportion were used for nominal variables, median and range for ordinal variables, mean and standard deviation for interval/ratio variables.

To determine the difference between estimated and actual birthweights, paired Sample T-test was used. Test on Proportions was used to determine the difference in proportion of estimated birthweights between palpation and Johnson's.

The accuracy of both palpation and Johnson's were analyzed. Bland-Altman analysis was used for interval/ratio variables to see limits of agreement and the mean difference between estimated birthweight using both methods to actual birthweight. To determine the precision of palpation and Johnson's, the F-test of equality of variances was used.

Lastly, one-way ANOVA was used to determine the difference of mean among categories of possible effect modifiers of palpation and Johnson's.

All valid data were included in the analysis. Missing variables were neither replaced nor estimated. Null hypothesis was rejected at 0.05α-level of significance. STATA 15.0 was used for data analysis.

## RESULTS

***Study Population***

Demographics of the 140 parturients included in the study are summarized in Table 1. Median age of parturients was 24 years old and majority had normal body mass index (BMI) range (65%). Fifty percent of parturients were primigravid. Approximately 69% had a cervical dilatation of at least 6 centimeters and 55% had an unengaged labor.

EFW using palpation and Johnson's were compared to actual birthweight. Results were analyzed by comparing the mean EFW of each method to mean actual birth weight. Mean EFW was 2846.39 ± 427.29g by Johnson's and 2904.29 ± 372.79g by palpation. The

**Table 1.** Demographic profile of parturients (n=140)

| | Median (Range); Frequency (%); Mean ± SD |
|---|---|
| Age, years | 24 (14 to 43) |
| BMI | |
| <18.5 | 14 (10) |
| 18.5-24.99 | 91 (65) |
| 25-29.99 | 24 (17.14) |
| ≥30 | 11 (7.86) |
| Gravidity | |
| G1 | 70 (50.00) |
| G2 | 32 (22.86) |
| G3 | 21 (15.00) |
| G4 | 8 (5.71) |
| ≥G5 | 9 (6.43) |
| Parity | |
| P0 | 70 (50.00) |
| P1 | 33 (23.57) |
| P2 | 22 (15.71) |
| P3 | 7 (5.00) |
| P4 | 4 (2.86) |
| ≥P5 | 4 (2.86) |
| Cervical dilation, cm | |
| <6 | 43 (30.71) |
| ≥6 | 97 (69.29) |
| Labor engagement | |
| Unengaged | 77 (55.00) |
| Engaged | 63 (45.00) |

mean actual birthweight was 3028.30 ± 441.52g. Using paired t-test, no significant differences were found in EFW by both methods.

***Frequency distribution on weight differences: Palpation method versus Johnson's Rule***

The weight difference between EFW and actual birthweight for both methods were analyzed using Test on Proportions. Table 2 shows the frequency distribution of weight differences between two clinical methods. There was a significantly larger proportion of estimates that differed from actual birthweights by < 100 grams (41.43% for palpation and 13.57% for Johnson's, p < 0.001), > 500 grams (7.86% for palpation and 17.86% for Johnson's, p = 0.003) in palpation versus Johnson's. By using palpation, EFW has a smaller difference from actual birthweight.

***Accuracy and Precision of Fetal estimation: Palpation method versus Johnson's Rule***

Table 3 shows the agreement between estimated and actual weight for the two methods. Using Bland-Altman test, the agreement in fetal weight derived from palpation and Johnson's with actual birthweight

**Table 2.** Frequency distribution based on differences from actual birthweight

| Frequency | | | |
|---|---|---|---|
| | **Palpation** | **Johnson's Rule** | **p** |
| <100 grams | 58 (41.43) | 19 (13.57) | **<0.001** |
| 100-199 grams | 25 (17.86) | 26 (18.57) | 0.877 |
| 200-299 grams | 21 (15.00) | 29 (20.71) | 0.212 |
| 300-399 grams | 15 (10.71) | 21 (15.00) | 0.284 |
| 400-499 grams | 10 (7.14) | 20 (14.29) | 0.053 |
| ≥500 grams | 11 (7.86) | 25 (17.86) | **0.003** |
| *Statistical test used: Test on Proportions* | | | |

was determined. On average, palpation tends to underestimate actual size by 124.01 grams, while Johnson's underestimated actual birthweight by an average of 181.97 grams. However, Pitman's Test of difference in variance shows there is a statistically significant difference in variance between palpation and actual birthweight (r = -0.275, p = 0.001) and no statistically significant difference between Johnson's and actual birthweight (r = -0.0435, p = 0.613). As the actual birthweight increases, EFW of palpation tends to provide larger underestimation.

Overall, palpation had lower bias or mean percentage error (7.11%) compared to Johnson's (12.09%) as seen in Table 4. In addition, palpation provided more precise estimates to actual birthweight (7.39%) relative to Johnson's (9.32%) based on standard deviation percent error as depicted in Table 5.

Using a one-way ANOVA, mean difference on EFW and actual birthweight of both methods were analyzed in Table 6 among categories of predicted effect modifiers (BMI, engagement and cervical dilatation).

Analysis showed EFW derived from palpation were more accurate among normal (6.75% vs 12.19%, p < 0.001) and overweight mothers (6.11% vs 12.04%, p = 0.004). At the extremes of BMI, neither of the methods were superior to the other. There are no differences in the EFW of both methods from the actual birthweight across BMI categories.

In terms of engagement, EFW using palpation had more accurate measurements among mothers with unengaged (6.65% vs 12.24%, p < 0.001) and engaged fetal head (7.68% vs 11.91%, p = 0.002).

Palpation provided more accurate estimations among mothers who had cervical dilation of less than 6cm (7.10% vs 10.94%, p = 0.004) and those who had at least 6cm (7.12% vs 12.60%, p < 0.001).

The following factors were effect modifiers in the mean difference between actual and EFW: cervical dilation for palpation, and engagement for Johnson's.

**Table 3.** Bland-Altman agreement between estimated and actual weight

| | Palpation method | Johnson's rule |
|---|---|---|
| Limits of Agreement | -650.78 to 402.75 | -908.00 to 544.18 |
| Mean difference of estimated weight and actual weight (95% CI) | -124.01 (-168.03 to -80.00) | -181.97 (-242.57 to -121.242) |
| Range | 2125.00 to 4310.00 | 2050.00 to 4247.50 |
| Pitman's Test of difference in variance ® | -0.275 | -0.043 |
| P-Value | 0.001 | 0.613 |

**Higher concordance as Pitman statistic approaches 0.*

*Limits of agreement = mean diff. ± 1.96*std dev. We expect that 95% of the differences will lie within the limits of agreement.*

*95% CI of the mean diff. = mean diff ± SEM*t value for n-1 degrees of freedom.*

**Table 4.** Accuracy of palpation and Johnson's method in estimating actual birthweight

| | Bias (Mean absolute percent error) | | |
|---|---|---|---|
| | **Palpation Method** | **Johnson's Rule** | **P** |
| Overall | 7.11% | 12.09% | <0.001 |
| BMI | | | |
| <18.5 | 8.12% | 11.85% | 0.085 |
| 18.5-24.9 | 6.75% | 12.19% | **<0.001** |
| 25-29.9 | 6.11% | 12.04% | **0.004** |
| >29.9 | 10.26% | 9.76% | 0.583 |
| Engagement | | | |
| Unengaged | 6.65% | 12.24% | **<0.001** |
| Engaged | 7.68% | 11.91% | **0.002** |
| Dilation | | | |
| <6 cm | 7.10% | 10.94% | **0.004** |
| ≥6 cm | 7.12% | 12.60% | **<0.001** |

**Table 5.** Precision of palpation and Johnson's method in estimating actual birthweight

| | Precision (SD percent error) | | |
|---|---|---|---|
| | **Palpation method** | **Johnson's Rule** | **P** |
| Overall | 7.39% | 9.32% | **0.003** |
| BMI | | | |
| <18.5 | 6.80% | 10.92% | **0.050** |
| 18.5-24.9 | 7.37% | 9.44% | **0.010** |
| 25-29.9 | 6.41% | 8.66% | 0.078 |
| >29.9 | 9.87% | 5.92% | 0.939 |
| Engagement | | | |
| Unengaged | 6.18% | 8.97% | **<0.001** |
| Engaged | 8.67% | 9.79% | 0.171 |
| Dilation | | | |
| <6 cm | 6.34% | 7.89% | 0.081 |
| ≥6 cm | 7.85% | 9.88% | **0.013** |

*Statistical test used: F-test on Equality of Variances*

**Table 6.** Estimated and actual fetal weight by BMI, engagement, and dilatation

| | n | Actual birthweight | Estimated birthweight | Mean difference (95% CI) estimated - actual | p |
|---|---|---|---|---|---|
| | Freq | Mean ± SD | | | |
| **Palpation method** | | | | | |
| Overall | 140 | 3028.30 ± 441.52 | 2904.29 ± 372.79 | -124.01 (-168.03 to -80.00) | <0.001* |
| According to BMI | | | | | 0.950† |
| <18.5 | 14 | 2745.71 ± 417.57 | 2628.57 ± 322.08 | -117.14 (-255.63 to 21.34) | 0.091 |
| 18.5-24.9 | 91 | **3004.35 ± 403.42** | **2885.71 ± 344.02** | **-118.64 (-173.34 to -63.94)** | **<0.001** |
| 25-29.9 | 24 | **3199.83 ± 404.57** | **3050.00 ± 350.16** | **-149.83 (-241.33 to -58.34)** | **0.003** |
| >29.9 | 11 | 3211.82 ± 645.86 | 3090.91 ± 500.91 | -120.91 (-388.47 to 146.65) | 0.338 |
| Engagement | | | | | 0.282* |
| Unengaged | **77** | **2998.39 ± 400.05** | **2896.10 ± 350.35** | **-102.29 (-156.30 to -48.27)** | **<0.001** |
| Engaged | **63** | **3064.86 ± 488.27** | **2914.89 ± 401.15** | **-150.57 (-223.91 to -77.23)** | **<0.001** |
| Dilatation | | | | | 0.003* |
| <6 | 43 | 2881.30 ± 458.65 | 2855.81 ± 398.39 | -25.49 (-108.26 to 57.28) | 0.538 |
| ≥6 | 97 | **3093.46 ± 419.83** | **2925.77 ± 360.92** | **-167.69 (-218.09 to -117.30)** | **<0.001** |
| **Johnson's method** | | | | | |
| Overall | 140 | **3028.30 ± 441.52** | **2846.39 ± 427.29** | **-181.97 (-242.57 to -121.24)** | **<0.001** |
| According to BMI | | | | | 0.695† |
| <18.5 | 14 | 2745.71 ± 417.57 | 2579.64 ± 289.07 | -166.07 (-380.94 to 48.80) | 0.119 |
| 18.5-24.9 | 91 | **3004.35 ± 403.42** | **2801.81 ± 402.98** | **-202.54 (-276.37 to -128.70)** | **<0.001** |
| 25-29.9 | 24 | **3199.83 ± 404.57** | **3028.96 ± 411.31** | **-170.88 (-333.53 to -8.22)** | **0.040** |
| >29.9 | 11 | 3211.82 ± 645.86 | 3156.36 ± 524.59 | -55.45 (-321.94 to 211.03) | 0.653 |
| Engagement | | | | | **0.015*** |
| Unengaged | 77 | **2998.39 ± 400.05** | **2749.61 ± 375.76** | **-248.78 (-318.99 to -178.57)** | **<0.001** |
| Engaged | 63 | 3064.86 ± 488.27 | 2964.69 ± 458.70 | -100.17 (-202.74 to 2.39) | 0.055 |
| Dilatation | | | | | 0.183* |
| <6 | 43 | **2881.30 ± 458.65** | **2760.93 ± 480.94** | **-120.37 (-223.29 to -17.45)** | **0.023** |
| ≥6 | 97 | **3093.46 ± 419.83** | **2884.28 ± 398.05** | **-209.19 (-284.45 to -133.92)** | **<0.001** |

*Statistical test used: * Test on Proportions, † One-way ANOVA*

## DISCUSSION

Accurate estimation of fetal weight is vital in the management of labor and timing of delivery. Methods and instruments therefore are being used to approximate the fetal weight, but have a certain degree of inaccuracy. Several studies used ultrasound and compared different formulas or clinical methods to estimate birthweight. In the present study, two clinical methods were compared.

Goetzinger (2014) showed that correlation between actual birthweight and clinical estimation was poor.[20] Conversely, some studies showed that clinical methods provide estimates close to actual fetal weight. Some studies showed that Johnson's was as accurate as ultrasonographic estimates.[22,23] Other studies concluded that estimates based on palpation were as accurate or even better than ultrasound.[9,18,24-26] The present study showed that palpation was better than Johnson's.

This study evaluated and categorized the weight differences of estimates in grams (<100g, <500g, <750g). Majority of estimates from palpation were within less than 100 grams from the actual birthweight. By using palpation, a reliable estimate can be made and the appropriate method of delivery achieved.

Accuracy of palpation was measured by bias or mean absolute error. Palpation had lower bias or systematic error, hence was more accurate. In addition, palpation provided more precise estimates to actual birthweight.

In a study by Field et al, maternal obesity did not affect the accuracy of fetal weights.[10] Consistent with our results, the study demonstrated no significant difference in mean difference across BMI categories

for both methods. In parturients with normal BMI and overweight, palpation was better. For underweight and obese parturients, the difference in absolute percentage error between the methods are not significant, therefore no preferred clinical method. It is possible that the increased thickness of abdominal wall in obese patients contributes to this difference.

There are limited studies on the topic of variables that may affect the accuracy of EFW. In the study of Goetzinger et al (2014), fetal station or engagement had no significant impact on the accuracy of clinical EFW.[20]

In parturients with engaged and unengaged fetal head, palpation had more accurate estimates. Estimates from Johnson's were more accurate in pregnant patients with engaged compared to unengaged fetal head. This may be due to the inherent nature of the method where amniotic fluid and nutritional status are concurrently measured in an unengaged fetal head.

In parturients with cervical dilatation of less than 6 cm or in latent labor, palpation provided estimates closer to actual birthweight. During advanced labor (>6cm), estimates of palpation were farther from the actual birthweight. This may be due to frequent contractions that occur during the advanced labor, hence difficulty in assessment. Using Johnson's, estimates were not affected by the cervical dilatation possibly because fundic height was not affected by frequent uterine contractions.

Previous studies showed that experience increases accuracy of fetal estimates of palpation.[20] This was supported by a local study done by Asto and Crisologo, where palpation was the routine clinical method of estimation.[18] In contrast, the present study was done in a setting where Johnson's was the routine clinical method. Despite the difference of routine clinical practice, both studies showed that palpation was superior to Johnson's. Although experience increases the accuracy and precision of palpation, the lack of experience does not make palpation inaccurate. The strength of palpation therefore is not dependent on the experience of the operator.

Palpation provides a simple, easy and accurate way of estimating fetal weight. For this reason, it can be used in primary health care (lying in clinics and local health center) and be performed by midwives and doctors even in remote areas. Moreover, because a learning effect is inherent the more it is practiced and used, the accuracy of palpation is expected to increase. As a result, there will be improvement in maternal health care through proper assessment and timely referral to tertiary hospitals if needed. Eventually, maternal and perinatal morbidity will be reduced.

The strengths of our study are that we present prospective data resulting from a realistic assessment of pregnant women as they arrived at our institution for delivery. The study has an adequate sample size to power the overall conclusion that palpation is better than Johnson's in estimating fetal weight. Furthermore, the effect modifiers on the accuracy of both clinical methods were analyzed in the study.

Despite there being an appropriate sample size for the overall conclusion, the sample size for each category of BMI was insufficient. To improve this, further studies with increased sample size to power each group is needed. Additional studies can be conducted to include presence of intact bag of water as an effect modifier. A similar study can be made to identify presence of inter-observer variability in EFW across all residency levels.

## CONCLUSION

Clinical methods such as Johnson's and palpation are both effective and convenient tools in estimating fetal weight. Both methods are straightforward, costless and simple. This study concluded that palpation was the better clinical method in estimating fetal weight in our population. The majority of estimates from palpation were within less than 100 grams from the actual birthweight. By using palpation, a reliable estimate can be made and the appropriate method of delivery achieved. Though perceived to be subjective, palpation is accurate and precise in measuring fetal weight.

In this study, effect modifiers were determined and analyzed. Accuracy of both methods were not affected by the BMI. Engagement resulted to closer estimates to actual birthweight in Johnson's whereas in palpation, estimates were not affected. Cervical dilatation of less than 6cm resulted to estimates close to actual birthweight in palpation, however in Johnson's estimates were not affected.

In spite of the lack of resources where an ultrasound is an extravagance to many, maternal health care should not be compromised. Effective health care does not require expensive tools in proper management. Instead, it requires health care professionals who can execute accurate but practical methods. ■

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